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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/558,053 | 04/26/2000 | Hisako Apyama | 0039-7684-2 SRD DIV | 9571 |

7590 02/07/2002

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EXAMINER

MALDONADO, JULIO J

| | |
|----------|--------------|
| ART UNIT | PAPER NUMBER |
|----------|--------------|

2823

DATE MAILED: 02/07/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/558,053

Applicant(s)

APYAMA ET AL.

Examiner

Julio J. Maldonado

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 November 2001.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 29-40 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 29-40 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

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DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claim 29-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chow et al. in view of Mu et al. (U.S. 5,612,254) and Roth et al. (U.S. 5,272,117).

In reference to claim 29 Chow et al. (Fig.2-6) shows an analogous method to form multi-level metal/insulator films including the steps of forming a first insulating film (5) on a semiconductor substrate (3); forming a second insulating film (6) on said first insulating film (5), said second insulating film (6) is made of a material different from that of the first insulating film (5) and having a thickness smaller than that of the first insulating film (5); forming a third insulating film (8) on said second insulating film (6), said third insulating film (8) is made of material different from that of the second insulating film (6) and has a thickness larger than that of the second insulating film (6); forming a groove in said third insulating film (8) having a bottom to which said second insulating film (6) is exposed; removing a part of that portion of the second insulating film (6) which is exposed to the groove, and a part of the first insulating film (5) under the portion of the

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second insulating film (6), and thus forming a contact hole reaching to the semiconductor substrate (3) and burying the groove and the contact hole (7) with a metal to form a metal wiring (9) in said groove and a metal contact in said contact hole (7).

However, Chow et al. does not teach removing the second and first insulating film using the same etching mask. Nevertheless, Mu et al. (column 6, lines 8–15) in an analogous method to form interconnects in a semiconductor substrate teaches the step of removing a portion of the second insulating film (23) and of the first insulating film (22) under said portion of second insulating film (23) using the same etching mask, and thus forming a contact hole reaching to the semiconductor substrate (20).

Given that both, Chow et al. and Mu et al. are drawn to the formation of interconnects on semiconductor devices, it would have been within the scope of one of ordinary skill in the art to combine the teachings of the references to remove the second and first insulating film using the same etching mask.

In reference to claims 30-39, Chow et al. fails to teach that the first and third insulating films are substantially SiO_2 and that the second insulating film is formed of Si_3N_4 ; forming a Nb barrier film; depositing a carbon film on the third insulating film; forming a metal wiring of Al or Cu; and forming another Nb barrier layer on said metal barrier.

Nevertheless, Mu et al. (Fig.9) teaches using SiO_2 (doped or undoped) and Si_3N_4 as insulating materials; forming a barrier metal film of Nb on the inner

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surfaces of the groove and contact hole; forming a Cu or Al wiring layer; and forming another Nb barrier layer on said metal barrier (column 4, lines 38-55 and column 8, lines 39-67).

It would have been obvious to one of ordinary skill in the art to combine the teachings of Chow et al. and Mu et al. for an expectation of success. The motivation/suggestion would have been that the above-mentioned materials are well-known in the art. The selection of a known material involves only routine skill in the art.

Still, although Chow et al. teaches forming a passivation layer over the third insulating film (column 4, lines 1-7), fails to teach that such film comprises carbon. Nevertheless, Roth et al. (column 3, lines 51-62) teaches forming a passivation layer (18) formed of carbon.

It would have been obvious to one skilled in the art to include the teachings of Roth et al. into those of Chow et al. to arrive at the claimed invention. The motivation/suggestion would have been that carbon is well-known material that may be used as a passivation layer. The selection of known materials involves only routine skill in the art.

3. Claim 40 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chow et al (U.S. 4,789,648) in view of Cochran et al. (U.S. 4,832,789).

In reference to claim 40 Chow et al. (Fig.2-6) shows an analogous method to form multi-level metal/insulator films including the steps of forming a first insulating film (5) on a semiconductor substrate (3); forming a second insulating

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film (6) on said first insulating film (5), said second insulating film (6) is made of a material different from that of the first insulating film (5) and having a thickness smaller than that of the first insulating film (5); forming a third insulating film (8) on said second insulating film (6), said third insulating film (8) is made of material different from that of the second insulating film (6) and has a thickness larger than that of the second insulating film (6); forming a groove in said third insulating film (8) having a bottom comprising said second insulating film (6); removing a portion of first insulating film (5) to expose the substrate; and forming a wiring material (9) in said groove.

However, Chow et al. does fails to teach that the wiring formation steps comprises etching through second insulation film to expose said first insulation film while leaving a remaining portion of said second insulation film.

Nevertheless, Cochran et al. (Fig.6) teaches the steps of removing a portion of the third and second insulating film (27 and 25, respectively), thereby forming a groove, and depositing a wiring connection in said groove.

It would have been obvious to one skilled in the art at the time the invention was made to incorporate the teachings of Cochran et al into Chow et al. for an expectation of success. The motivation/suggestion would have been that etching the insulating films and etch-stopping layers involves only routine skill in the art (column 3, lines 20-23).

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Response to Arguments

4. Applicant's arguments filed 11/29/2001 have been fully considered but they are not persuasive.

Applicants argue that the references already cited "...dot not remedy the deficiencies in Chow et al..." since these references does not suggest using the same etching mask to remove the second and first insulating film, thus forming a contact hole (page 4, lines 9-13).

In response to these arguments, Mu et al. (Fig.3) and Cochran et al. (Fig.3 and Fig.6) teaches using the same etching mask for removing portions of the second and first insulating films, exposing the substrate. Specifically, Cochran et al. teaches that these methods are well-known in the art (Cochran et al., column 3, lines 20-23). Therefore, the references disclose the step of removing second and first insulating film using the same mask. And since these references are drawn to the formation of metal interconnects and semiconductor integrated circuits, there is motivation to combine them to remedy the deficiencies of Chow et al.

Conclusion

5. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory

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action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

6. Papers related to this application may be submitted directly to Art Unit 2823 by facsimile transmission. Papers should be faxed to Art Unit 2823 via the Art Unit 2823 Fax Center located in Crystal Plaza 4, room 3C23. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2823 Fax Center number is **(703) 305-3432**. The Art Unit 2823 Fax Center is to be used only for papers related to Art Unit 2823 applications.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Julio J. Maldonado** at **(703) 306-0098** and between the hours of 8:00 AM to 4:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via julio.maldonado@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on (703) 308-4918.

8. Any inquiry of a general nature or relating to the status of this application should be directed to the **Group 2800 Receptionist** at **(703) 308-0956**.

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9. The following list is the Examiner's field of search for the present Office

Action:

| Field of Search | Date |
|--|------------|
| U.S. Class / Subclass(es): 438/14, 438/624, 438/633, 438/634 | 01/31/2001 |
| Other Documentation: | |
| Electronic Database(s): EAST (USPAT) | 01/31/2001 |

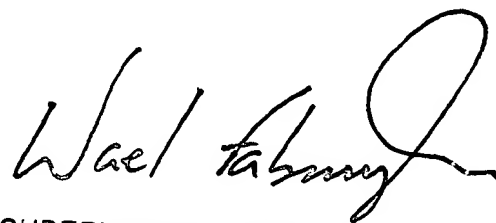
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